On Being Invisible

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I.

The Qualities of Change

Much music is conceived physically under the broader concept of resonance. This includes the conception of the physical materials of music as being embodied in the geometry of vibrations of air molecules in a bounded space, inside which the concept of the "outside" of this space is meaningless. I am interested in the properties of universality that involve music unbounded by this multi-dimensional, enclosed continuum. We remember the one eyed, sessile philosopher who could only conceive of a crude elliptic, two-dimensional space. The three-dimensional form of tactual space is resultant from the combination of images from two eyes and is given meaning that is conditioned in part by the semi-circular canals of the ear, the changes of which are **cross or cross**-correlated with the dynamic, myogenetic forms of extension, contraction, and resistance to gravity. What, then is the latest sense, or abstract "third eye" which will enable us to create a music that articulates itself physically through universals of experience with all of space. Kant maintained that space is not an empirical concept derived from external experience, but a framework already existing in the mind without which no external phenomena would be possible. Poincaré points out that, just as the Principle of Relativity tries to show us that it is impossible by any means to obtain knowledge of absolute motion, so, it is theoretically impossible to determine what are the qualities of matter as "distinct" from those of space. Therefore, it is beyond our power to obtain knowledge of absolute space.

Time may be thought of simply as that dimension in which we "move" in order to articulate the remaining dimensions. It is the arbitrarily chosen dimension for "motion" in our normal conception of space. It need not be fixed as the only one, however. It is simply that dimension upon which our scanning mechanism for obtaining information about the others is focused at this stage in evolution. We, therefore, consider it as anisotropic in order that we may rely on memory processes to produce correlations and consequent reductions on the data of experience. In an elliptic space, however, time does not need to be considered anisotropic. Consider the bi-directionality from which any star may be observed in such a space, assuming no loss by absorption over the remaining axes. The different views of space observable from two opposite directions, then, represent a bi-directional articulation of information represented on three axes of our space by "motion" on a fourth. Time may then also be thought of simply as a means of generating shared experience, of observers sufficiently close to each other, about information articulated on the remaining axes. Rhythm in music, then, the material of time with which music is so fundamentally involved, may also be thought of as simply a means of generating shared experience of material information articulated on the remaining musical axes.

We may now look for that yet untapped sense which will enable us to synthesize through correlation an idea of resonance unbounded by our anisotropic view of time. Music more universal than that presently articulated by the elasticity of local compactings of air molecules will then arise. Psychotronic research in communication, which is really an art-science of transformation along one or more axes of conception with maximum invariance, along with work on our new views of physics and the self-organizing universe, may contribute to the awakening or reawakening of that sense which will lead to this fundamentally important step in evolution.

Correlation in three-space is partially accomplished by cross-correlation of energy patterns obtained from the two eyes. This is certainly a totally abstract process which gains its meaning through the aforementioned tactual and kinesthetic senses. The development of these and related processes arise primarily out of our need, as local concentrations of sameness, to locate other energy sources. Our anisotropic view of the remaining dimension of experience, time, arises from our conception of memory. The mechanisms of memory allow for correlations of information arising from different points on the time axes, just as our visual-tactual mechanisms allow for correlations of information arising from different points on the normal spatial axes. These allow localizations of perception to arise. However, from whence arises the notion that one of these concentrations is located “first” or “last” on a particular axis? Only as it relates to the preprogrammed nature of our ontogenetic growth! And this directional growth arises only from bounded-ness and its resultant shaping of statistical potentiality. Temporal correlation of two concentrations, A and B, requires the storage of A ‘til the occurrence of B, thus, our conception of the anisotropic nature of that axis upon which our scanning mechanism focuses in order to reduce data and generate shared experience.

Possibly, this new sense will embody a conception of some sense of non-directional correlation as distinct from our present conception of one-way memory storage. The hypotheses of elliptic geometry lead to the result that a star would be visible in opposite directions. This would be true except for the finite rate of propagation of light in space. These assumptions result in the case that the two images of the star seen in opposite directions will represent the star at different points on the time axis. If these two images were capable of being superimposed through correlation (non-directional), just as the images from two eyes are superimposed to develop three-space, we may have the basis for the necessary change in the conception of memory and a view of the isotropic nature of all perceptual axes. This is the “time-eye-in-the-back-of-the-head” we may be looking for.

These assumptions may lead further to the notion that existence in all places at all times is a thoroughly plausible concept. However, just as we have learned that rigid physical objects are not necessarily invariant with respect to shape through transformations in space, so, too, we must realize that a locally differentiable concentration in universal space is not necessarily invariant with respect to information content through transformations over one or more axes of that space. One who achieves such a mode of existence in all places at all times, therefore, can not communicate, in the above sense of communication, with another who has not. He or she may merely affect the other! The action required to accomplish this state may only require putting an existing structure to some purpose to which it has not been put in recent time.

II.

On Being Invisible

"On Being Invisible" is the title of a continuously developing body of work for soloist deriving from the author-composer's work in extended musical interface with the human nervous system, (1), (2), (3), (4). Though one idea has certainly been that of increasing the palette, bringing previously unconscious processes into conscious awareness and potential use, this work has led to the realization that the stability of natural oscillators is such that one can submerge him/herself in them and learn about the relationship between resonance and the idea of initiating action. This has profoundly influenced my understanding of the meaning of change in my music and constitutes the psychic space in which the major explorations of this piece take place.

During a performance of "On Being Invisible" inputs to an electronic instrument that comprise the performing actions are derived from signals from the brain, short term, manual actions, and signals from small acoustic instruments and the voice. What's going on inside the hardware may be best understood by extending our usual conception of the idea of an instrument. An instrument, in this system, is defined as a set of data that establishes all system interconnections, information flow paths, analytical or generative algorithms, and a stimulus-response mapping from inputs to outputs. A general purpose computer is used to store a library of such "instruments" and can initiate any of them nearly instantaneously, when an appropriate, predefined "stimulus" is detected by it. The computer also analyzes input signals in such a way that it can detect things like patterns of resonance, rhythmic events, spectral composition, degrees of regularity, and degrees and types of rates of change used to detect structural features that mark off cohesive temporal groupings of events in the input or output streams. Special purpose computers are used to generate and control the actual sound waveforms heard.

During Part I of the piece, (first realized in 1976), the performing actions are all derived from brain signals or from touch sensitive keyboard responses. The brain signals are analyzed in two ways. First, they are subjected to an auto-correlation analysis used to extract patterns from the brain signals that tend towards regularity. This is done by comparing the sampled signal to many stored versions of itself that are incrementally delayed in time. This determines how closely the patterns present at any given moment are related to patterns that occurred in the recent history of the signal. The most obvious mapping of the results onto sound occurs in the way these detected patterns are used to influence the flow of musical time, rhythm, in the production of some melodic contours, and in the generating of clouds of timbral relationships in, especially percussive, “instruments”. Second, the signals are analyzed so as to show how their energy is distributed throughout the frequency spectrum. The presence or absence of energy in a particular range, together with a measure of how regularly this energy is pulsating, generates stimuli for the initiation of “instruments” and rhythmic sequences. The touch sensitive keyboard responses are used to initiate new instruments and are played contrapuntally with the above brain signal events.

During Part II of “On Being Invisible”, performing inputs come almost exclusively from small acoustic instruments or the voice. In this case, the computer listens to and analyzes the sound fed to it through a microphone and looks for resonant acoustic patterns in the sound as it appears in the performance space. It tries to adjust the parameters of the sound it generates so as to complement the resonant patterns it finds. Of course, it is also always listening to itself as well as to the acoustic instruments or voice. An essential characteristic of most of the “instruments” programmed for this section is that they all tend to move towards some type of acoustic balance. One could make an analogy with the action of the skin of a large drum. One plays it by striking or rubbing it in some manner, the effect of which actions is to displace the elastic head from its state of rest. The performer then rests and listens to the sound produced by the head, which represents the process it goes through in order to return to its state of rest. So, the method of playing the “instruments” involves making a sound into their microphone, ear, and listening, then to a process by which the “instrument” may achieve a balanced state. The term, balance, here may be thought of in the abstract, since one may program the nature of sound complements that constitute an hypothetical state of homeostasis. As a performer, one must practice the ways in which one can become involved in initiating actions which allow inaction between the sounds, during which time one listens to the sounds freely articulating a natural process of motion towards a set of static complements. It is during this listening phase when the most difficult work arises. Here one must adjust one’s performing consciousness in order to choose the best moments to become an initiating force and decide on how.

It is an essential characteristic of all parts of this piece that the performer must constantly ride a borderline between being, on the one hand, an initiator of action and, on the other, submerging him/herself in processes larger than him/herself. This requires that the performer become adept at manipulating his/her state of consciousness, application of willful actions, and the energizing or programmed personal response modes. This requires a great deal of practice and is the inspiration for the title, “On Being Invisible”, (5).

Part III of “On Being Invisible” has not been realized in live performance to date. Research and development in preparation for it has been going on for some time, however. It involves detection and analysis of auditory evoked responses from the brain, the details of which can reveal a number of important features of activity occurring on various levels of the musical information processing hierarchy. These constitute electrophysiological correlates of formal perception. It is intended that changes in these signals be used to cause the music output to converge upon coherent forms or, possibly, even language structures and to diverge from them as the processes of selective attention become locked and unlocked to important structural features of the sonic stream. Laboratory research leading up to this has raised many questions about perception and music theory and has spawned ideas for language structures to be used in computerized electronic music instruments. Some of these ideas are described below.

III.

Steps Towards Transitional Topologies of Musical Form

Some of the background research began with the application by the author in 1968 of techniques of measurements and analysis of electrical brain activity to the study of musical experience and the use of biofeedback as an homeostatic stabilizer of perceptual processes and conscious states for study and analysis, (3). As progress developed in articulating features of musical information processing, new techniques allowed for the extracting of electrical concomitants in nervous system activity of finer and finer details of responses to structural landmarks in musical stimuli, (4), (6). Experiments were devised in which significant aspects of the structure of an evolving musical fabric were brought under the control of information derived from ongoing and evoked responses of the brain, which were time locked to events contained in those same structural aspects. From these experiments it was possible to make numerous observations about the "perceptual" versus the assumed "structural" significance of musical events for which brain responses were being analyzed. The work of several other researchers, notably, R. John on the exogenous versus endogenous aspects of neural activity and their relation to learning and memory, (7), M. Clynes on morphological invariants of output forms of the nervous system involved in expressive activity, (8), J. Tenney on temporal gestalt organization in musical perception, (9), and D. Rothenberg on the mathematical modeling of feature detecting systems, (10), lent considerable inspiration and theoretical support to the observations.

These observations about perceptual significance, as seen in brain signals, however, do not always bear an obvious relationship to the significance of events that might be suggested by the compositional system used. In addition, when the relationship is obvious, it does not always parallel the musical theory. This leads naturally to a re-examination of theoretical practices applied in composition and their relationship to natural language. It is imperative that such a re-examination of music theory be based on information arising from studies in psychoacoustics and higher levels of both neural and cognitive processing of musical input. This is especially true if the results are to be operationally significant, i.e., produce useable methodology that can be applied in both notated and non-notated composition as well as in the real-time, performing instruments of electronic music. The musical project, currently under development, is one whose results are intended to explore and test a subset of processes that are important to this newly evolving musical theory: "a topological method for recognition and manipulation of morphological, gesture shape units in musical expression".

A topological model is invoked because of its inherent flexibility in effecting transitional processes, between phonemic level elements, that reflect most naturally the mind's tendency to characterize the "qualitative" dynamics of the evolution of a form, (11). In this system, the composer specifies early in the compositional process a set of contour specifications. These may take the form of physical gestures, melodic contours, etc., and may be graphically input in the form of data or sensed in real-time by means of performance transducers. The composer chooses the gesture contours so as to comprise the major language elements of his/her work on as many hierarchically related levels of structure as he/she wishes. In the case of a real-time performance system, in which the gesture contours are input by means of action transducers, an adaptive, recognition algorithm is employed to enable the system to learn to partition and, subsequently, identify as stimuli, a repertoire of contours characteristic to a given performer. Such a technique also permits the creation of programs in which the composer may need only supply an economical set of "connectedness" relations among elements of the set of action stimuli and shape the system's response by means of simple feedback expressions, (12).

To effect the desired temporal evolution of the compositional structure, which is always described by means of a topological mapping of transition states, perturbations to effect mutation are introduced by means of a stochastic procedure. This procedure may, of course, be itself controlled by a contour input at the next level of the hierarchy. Next, a sequence-grouping detector is employed to separate out new contour vectors that are candidates for being output or inserted in the piece as new elements. This detector is inspired by a model for temporal gestalt organization, (9), and is modified to reflect the unidirectional rate-sensitive properties of input channels of the nervous system, (8). Once a sequence grouping is identified, it is subjected to a cross-correlation test with its associated prime contour element, as supplied originally by the composer. The result is a value, which may be tested against a criterion value supplied by the next level of control, which may itself be a dynamic, time-dependent function, comprising another such morphological gesture. If the test result is positive, the sequence may be output. The criterion or test value may be a dynamic variable or set of variables that describe adjacency relations in a user defined "concept space" of one gesture element to its neighbors over one or several dimensions of the topological map. In this way, the quality of transitions between two given elements may be controlled and a wide variety of such transitions is available. This is superior, for our purposes, to the more common means of effecting transitions by means of multiplicative or scale factor changes, (like mixing or cross-facing in electronic music), with which the quality of change effected in transmuting one given shape into another may only be varied with respect to speed.

The resultant output may be applied to all the vertical and horizontal parameters of music. From each level of the hierarchy, we may, then, derive a specification of form for the parameters of a given piece. Further, the levels may be related pyramid-ally, in ever broadening scope, from the micro- to the macro-structure of the piece, segment, or sound. One must also, of course, choose one's flavor of stochastic process with which to introduce mutations in the form of a particular gesture shape element, or leave this up to real-time control. By so doing, a natural movement through a network of topologically related elements is effected and will include the qualities of natural, gravitational, (resonant), clustering at different points linked by the network. Additionally, contours may be mapped over more than two dimensions, though, they must be related to at least one dimension such that their unfolding proceeds over larger and larger values of that dimension, (for instance, time), as we proceed upwards in the hierarchy. It is also important to remember that the entire process may reside in a computer assisted electronic music system and be invoked nearly instantly. The system may be thought of in this case as a temporally structured instrument, (13).

References/Notes

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4. Rosenboom, D.: PROLEGOMENON TO EXTENDED MUSICAL INTERFACE WITH THE HUMAN NERVOUS SYSTEM: AN OUTLINE MANDALA OF INSTRUMENTAL, ELECTROCORTICAL FORMS OBSERVABLE THROUGH POINT CONSCIOUSNESS, in Byron, M. (ed.): "Pieces: A Second Anthology", Pieces Press, Michael Byron Pub., Toronto, 1976.
5. Though the author-composer has produced numerous other works involving bioelectronic monitoring of many performers and, sometimes, audience members, "On Being Invisible" is unique in its musical, theoretical, and conceptual content. It is not scored but is based on a large body of knowledge and experience accumulated over many years of personal work. Some performances by others using this title have been produced. It should be noted, however, that the author-composer does not consider these to be valid representations of the work. Some day it may be possible to map the essential features of the piece such that others can perform it. It is not now intended that this take place, however. There are other pieces that serve this purpose.
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